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### (54) Brush assembly

(57) A brush assembly 20 for an electric motor 10 has a base 22 which secures the brush assembly to a motor spider 18. A brush housing 24 is associated with the base and has first and second open ends 42, 44. A brush 28 defining an axis is movably positioned in the housing between the first and second open ends. The brush extends from one of the open ends of the housing.

The brush includes a surface 86 which is at a desired angle with respect to the brush axis. A biasing member 26 exerts a force on the brush to bias the brush into an electrical connection with a commutator 16. An electrical connector 30 electrically couples the brush to provide an electrical connection between the commutator and a power supply.

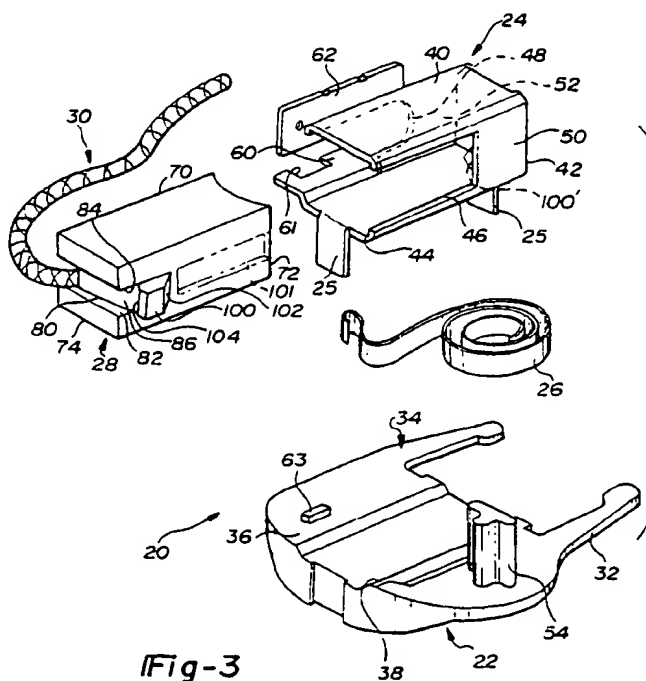


Fig-3

## Description

[0001] The present invention relates to electric motors and, more particularly, to brushes and brush assemblies.

[0002] Electric motors are used in various applications, as well as in a number of work-related areas. One area where small electric motors are utilized is in power tools. A brush is an integral part in transmitting power between a commutator and a power supply.

[0003] Various types of mountings which have springs are utilized to exert a force on the brush. The effectiveness of the brush and wear on the brush is decreased when the brush is subjected to arcing. Arcing is inherently present when the brush has a tendency to bounce or move away from the commutator and the brush hits irregularities over rough spots. US Patent 4,593,220 is typical of a brush assembly for power tool applications. US Patent 5,714,826 illustrates a brush assembly having a brush with an angled end wall for reducing brush vibration and arcing.

[0004] In accordance with one aspect of the invention, a brush assembly for electric motors comprises a base, the base includes a member for securing the base with a motor spider assembly. A brush housing is associated with the base. The brush housing has first and second open ends. A brush, defining an axis, is movably positioned in the housing between the first and second open ends. The brush extends from one of the open ends of the housing. A biasing member exerts a force on the brush. The brush is biased into electrical connection with a commutator. An electrical connector electrically couples with the brush to establish an electrical connection between the commutator and a power supply. The brush assembly is characterized in that the surface lies in a recessed portion of the brush.

[0005] According to the first aspect, the brush may also include a stop adjacent to the recessed portion. The housing may further include an axial slot in which the stop projects to prohibit further movement of the brush in the housing. The surface is preferably at an angle greater than zero with respect to a plane tangent the brush axis. Preferably, the angle is greater than zero to about ten degrees. The angle is such that the biasing member applies substantially constant force on the brush as the brush wears during use.

[0006] In accordance with a second aspect of the invention, a brush for an electric motor comprises a body having a desired configuration adapted for associating with a brush housing. The body defines an axis. A surface is on the body. The surface is on a desired angle with respect to a plane transverse to the axis. Also, the surface is at a terminal end of the body. The angle of the surface is greater than zero. The brush is characterized in that the surface lies in a recessed portion of the brush and enables a force applied by a spring on the surface to be substantially constant as spring moves on the surface when the brush wears.

[0007] According to the second aspect, preferably, the brush is a desired cross-sectional configuration and the recessed portion is positioned between a pair of members which extend from sides of the cross-sectional configuration. The angle of the surface is preferably between greater than zero degrees to about ten degrees. A stop may be unitarily formed on the brush and be adjacent the recessed portion. The recessed portion preferably extends a desired distance across the brush forming a second recess adjacent the recessed portion. An electrical contact is secured with the brush in the second recess.

[0008] According to a third aspect of the invention, a brush assembly for an electric motor comprises a brush box having opposed sides. A slot is formed in one of the sides. The body of the brush has a desired configuration adapted for fitting within the brush box. A surface is formed on a terminal end of the body on a desired angle greater than zero with respect to a plane transverse to an axis of the body. The assembly further comprises a bias member exerting a force on the surface for biasing the brush into electrical contact with a commutator. The assembly is characterized in that the surface enables the force exerted on said surface by the bias member to be substantially constant as said brush wears, that a stop is unitarily formed with said body; and that the stop is engageable with a wall of the slot to prohibit said brush from passing through the brush box.

[0009] Additional objects and advantages of the invention will be apparent from the detailed description of the preferred embodiment, the appended claims and accompanying drawings, or may be learned by practice of the invention.

[0010] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate one embodiment of the present invention and together, with the description, serve to explain the principals of the invention. In the drawings, the same reference numerals indicate the same parts.

[0011] Figure 1 is a perspective view of a motor including a brush assembly in accordance with the present invention.

[0012] Figure 2 is a perspective view of the brush assembly in accordance with the present invention.

[0013] Figure 3 is an exploded view of the brush assembly in accordance with the present invention.

[0014] Figure 4 is a plan view of the brush assembly in accordance with the present invention commutator shown in phantom in a first position.

[0015] Figure 5 is a figure like that of Figure 4 with a worn brush.

[0016] Figure 6 is a perspective view of a brush in accordance with the present invention.

[0017] Figure 7 is a perspective view of a power tool with a motor like Figure 1.

[0018] Figure 8 is a view like Figure 5 of a second embodiment of the present invention.

[0019] Turning to the figures, Figure 1 illustrates a mo-

tor removed from a power tool housing and is designated with the reference numeral 10. The motor includes a base 12, windings (not shown), commutator 16 and a spider 18. A brush assembly 20 is illustrated to couple with the motor spider 18.

[0020] The brush assembly 20 includes a base 22, a housing 24, a spring 26, a brush 28 and an electrical connection 30. The base 22 is preferably a non-metallic member having a pair of arms 32 and 34 to secure the base 22 with the motor spider 18. Also, the base includes a web 36 which connects the two arms 32 and 34. The web includes a recess 38 which receives the housing 24. The housing 24 is secured in the recess 38 by flaps 25 which are bent under the base 22 to secure the housing 24 with the base 22.

[0021] The housing 24 includes an open cylindrical member 40 having a rectangular cross-section. The cylinder has opened ends 42 and 44, the end 42 being adjacent the commutator 16. Slots 46 and 48 are positioned on sides 50 and 52 and extend from open end 44. The slots 46 and 48 enable the spring 26 and electrical connector 30 to move with the brush 28. Also, a unitary shunt connection member 60 and connector 62 are formed with housing 24. The connector 62 enables an electrical contact to be coupled with the housing 24. Also, the connection member 60 has a cutout 61 which interacts with tab 63 to enable positioning of the housing 24 on the base 22.

[0022] The spring 26 is wound about a post 54 extending from the base plate 22. The post 54 may be angled off center with respect to the axis of the base 22. The spring 26 applies a force onto the brush 28. The electrical connector 30 is known in the art as a pigtail connector or shunt. The end of the pigtail shunt is ultrasonically welded to the connection member 60.

[0023] The brush 28 has a body portion 70 with a pair of ends 72 and 74. The body has an overall rectangular cross-section. The end 72 is arcuate having several raised and recessed portions 76 and 78 which abut the commutator 16. The end 74 includes a recessed portion 80 between a pair of walls 82 and 84. The walls 82 and 84 are spaced from one another such that the end of the spring 26 is trapped between the walls 82 and 84 and rides on the surface 86.

[0024] The recessed portion 80 defines a bottom surface 86. The surface 86 is angled with respect to a plane transverse to the longitudinal axis 88 of the brush 28. The surface 86 is on an angle greater than zero to about ten degrees. Preferably, the surface 86 is angled between greater than zero to about five degrees. The angle of the surface 86 is such that the spring 26 applies a substantially constant force on the brush 28 as the brush wears during use. A second recess 90 is formed adjacent the first recess 80. The second recess 90 is deeper and includes a surface 92 where the pigtail 30 enters the brush 28.

[0025] A stop 100 extends from the brush 28. The stop 100 has a width equal to that of the recessed portion

surface 86. The stop 100 has an angled end 102 which abuts the bottom of housing slot 46 when the brush 28 becomes worn. Also, the stop 100 includes a surface 104 which acts to retain the spring end in the recess.

Accordingly, the spring end is prevented from dislodging from the brush 28. The stop 100 also prohibits the shunt from further travel in the housing to prevent the shunt tip from engaging the commutator and damaging the commutator surface. Further, during the automated assembly process, the stop 100 provides an alignment feature as well as a retention feature by prohibiting the brush from further movement toward to commutator. Additionally, as shown in phantom in Figure 3, the stop may be a bent portion extending from the housing 24 and a groove may be in the brush 28 eliminating the projecting stop 100.

[0026] The recessed portion bottom surface 86 enables the spring end to ride in the recess to provide constant contact with the brush 28. This constant contact provides the force which, due to the angle of the surface, provides a substantially constant force on the brush during wear of the brush. The constant force eliminates bouncing of the brush and therefore increases the brush wear and prohibits damage to the commutator. Also, it is preferred that the spring end, as it is applying the force, be as close to the brush as possible. This enhances the application of the constant force on the brush.

[0027] Since the brush has a simple design, it can easily be assembled with the brush assembly by an automated process. Also, the brush assembly may easily be assembled with the motor by an automated process.

[0028] Figure 7 illustrates a power tool 110, such as a drill motor. The power tool 110 includes a housing 112 which receives a motor 10, which is described above. Also, the power tool 110 includes an output member 114, in this case a chuck. A power cord 116 is coupled with the power tool 110 to supply power. Also, the tool 110 may be battery operated.

[0029] Figure 8 illustrates a second embodiment of the present invention. Figure 8 is similar to that of Figure 5, with the brush 28 as the only element which is different in this embodiment. Accordingly, the other features are marked with identical reference numerals.

[0030] The brush 28 is the same as that previously illustrated, except that the surface 86 is on an angle substantially steeper than that of the above design. Here, the angle is between 20° to 40°. Preferably, the angle is about 30°. Thus, the present invention enables a bottom surface 86 that can be angled at various positions to enable the constant application of force onto the commutator. As can be seen in phantom, the spring is near the axis of the brush as it moves from a beginning position to a worn position.

[0031] In summary, the present invention provides a number of advantages. The present invention provides a brush and brush assembly wherein a substantially constant force is applied to the brush. The present invention provides a brush which enables a spring to exert

a constant force onto the brush to reduce wear. The brush includes a surface where the resultant spring force applied on the surface, by the assembly spring, is substantially the same throughout the life of the brush. Also, a stop is present on the brush which prohibits undue wear on the brush by prohibiting further travel of the brush towards the commutator. This likewise prevents the shunt wire from engaging the commutator damaging the commutator surface. Further, the stop prohibits the spring from dislodging from the end of the brush.

[0032] It will be apparent to those skilled in the art that various modifications and variations may be made in the brush assembly of the present invention without departing from the scope or spirit of the present invention. Thus, it is intended that the present invention cover these modifications and variations provided they come within the scope of the appended claims and their equivalents.

#### Claims

1. A brush assembly for an electric motor comprising:
  - a base (22), said base including a member (32; 34) for securing said base with a motor spider assembly;
  - a brush housing (24) associated with said base, said housing having first and second open ends (42; 44);
  - a brush (28), defining an axis, movably positioned in said housing between said first and second open ends, and said brush extending from one (42) of said open ends of said housing, said brush including a surface (86), said surface being at a desired angle with respect to the brush axis;
  - a biasing member (26) exerting a force directly on said brush surface for biasing said brush into electrical contact with a commutator; and
  - an electrical connector (30) electrically coupled with said brush for electrical connection between the commutator (16) and a power supply characterized in that the surface lies within a recessed portion (80) of the brush.
2. A brush assembly as claimed in Claim 1, wherein said brush includes a stop (100) adjacent said recessed portion.
3. A brush assembly as claimed in Claim 1 or Claim 2, wherein said housing includes an axial slot (46), said stop projecting into said slot.
4. A brush assembly as claimed in any one of Claims 1 to 3, wherein said surface is at an angle greater than zero degrees and preferably upto about 40°, with respect to a plane tangent the brush axis
5. A brush assembly as claimed in any one of Claims 1 to 4, wherein said angle is such that said biasing member applies a substantially constant force on said brush as said brush wears during use.
6. A brush assembly as claimed in any one of Claims 1 to 5, wherein said electrical connector is positioned adjacent said surface.
7. A brush for an electric motor comprising:
  - a body (70) having a desired configuration adapted for fitting within a brush box (24), said body defining an axis;
  - a surface (36) on said body, said surface on a desired angle with respect to a plane transverse to said axis, said surface at a terminal end (74) of said body;
  - said angle being greater than zero degrees
 characterized in that
  - the surface lies in a recessed portion (80) of the brush and enables a force applied by a spring (26) on said surface to be substantially constant as the spring moves on the surface when the brush wears.
8. A brush as claimed in Claim 7, wherein said brush has a desired cross-sectional configuration and said recessed portion is positioned between a pair of members (82; 84) extending from sides of said cross-sectional configuration.
9. A brush as claimed in Claim 7 or Claim 8, wherein said angle is greater than zero degrees to about 40°.
10. A brush as claimed in any one of Claims 7 to 9, wherein a stop (100) is formed on said brush, preferably adjacent said recessed portion.
11. A brush as claimed in claim 10, wherein said stop is continuous with said recessed portion, and is preferably unitarily formed with said brush.
12. A brush as claimed in any one of Claims 7 to 11, wherein said recessed portion extending a desired distance across said brush forming a second recess (90) adjacent said recessed portion.
13. A brush as claimed in Claim 12, wherein an electrical contact (30) is secured with said brush in said second recess.
14. A brush assembly for an electric motor comprising:
  - a brush box (24) having opposed sides;

a slot (46) formed in one of the sides;

a body (70) having a desired configuration adapted for fitting within the brush box, said body defining an axis;

a surface (86) on said body, said surface on a desired angle with respect to a plane transverse to said axis, said surface at a terminal end of said body; 5

a bias member (26) exerting a force on the surface for biasing the brush into electrical contact with a commutator (16); 10

said angle being greater than zero degree;

characterized in that:

the surface enables the force exerted on said surface by the bias member to be substantially constant as said brush wears;

a stop (100) is unitarily formed with said body; 20

and

the stop is engageable with a wall of the slot to prohibit said brush from passing through the brush box. 25

15. A brush assembly as claimed in Claim 14, wherein the surface is formed in a recessed portion (80) of the brush and the stop is adjacent the recessed portion, the stop preferably being continuous with the recessed portion and having a surface (104) for retaining the bias member in the recessed portion. 30

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Fig-1

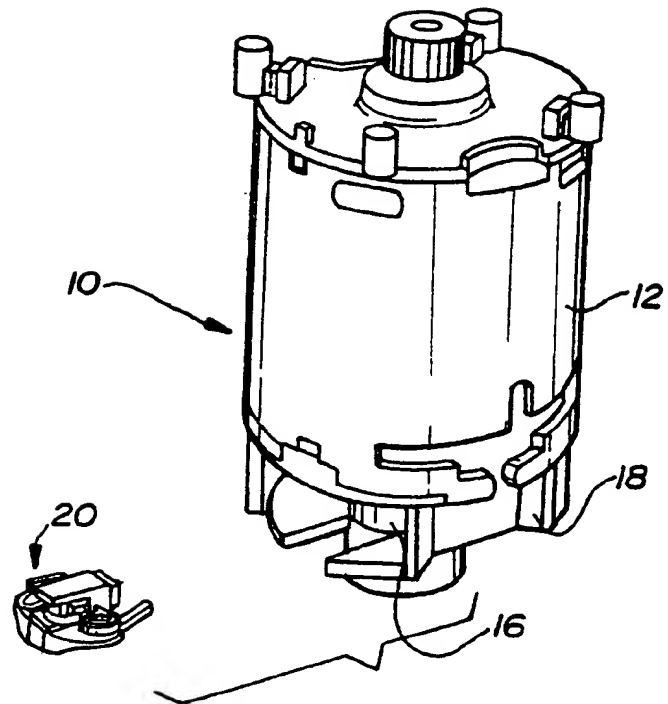
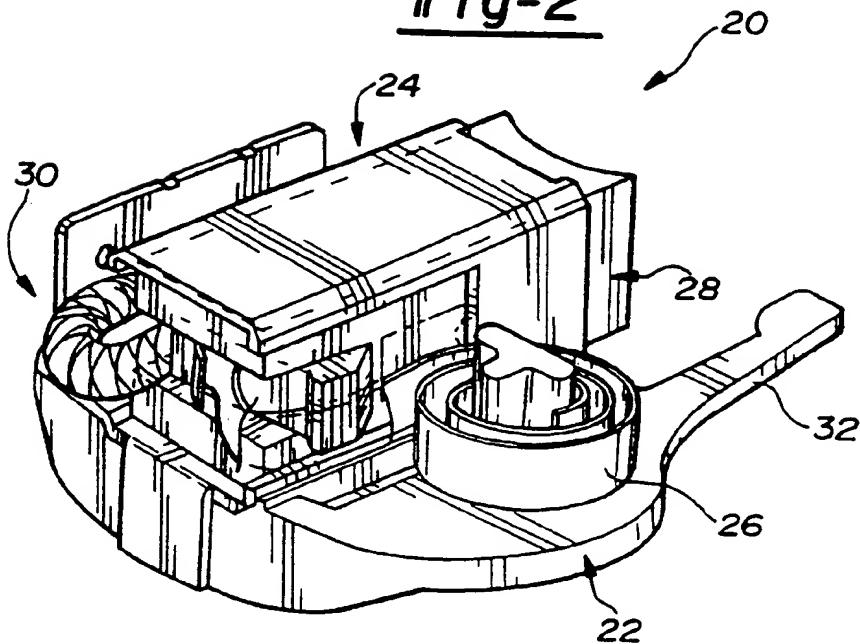
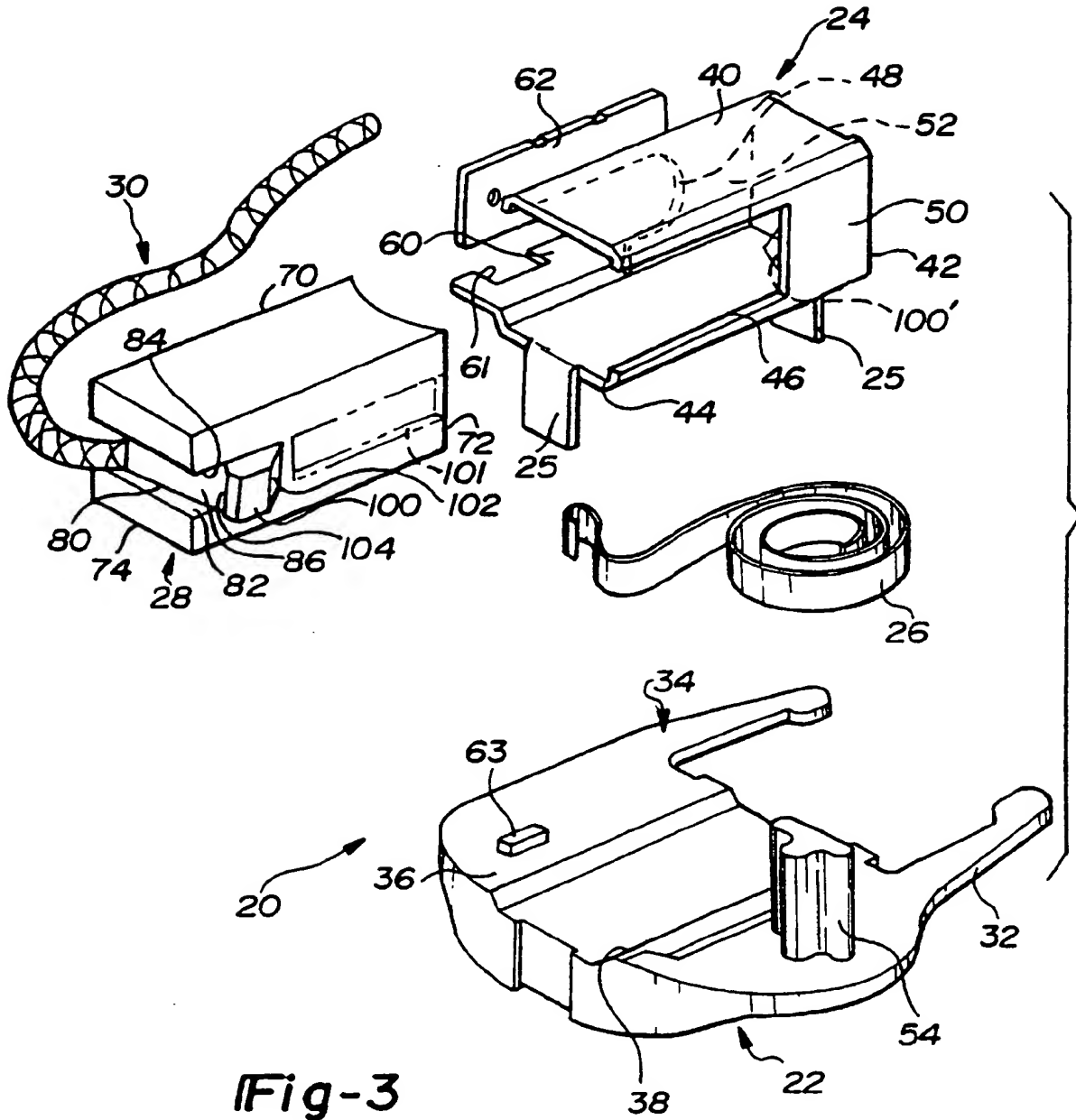
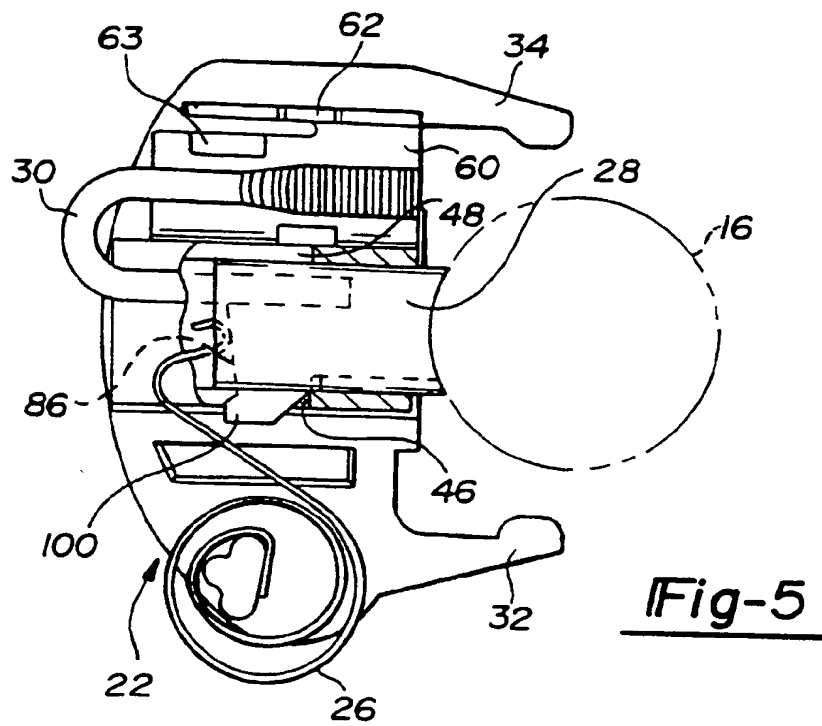
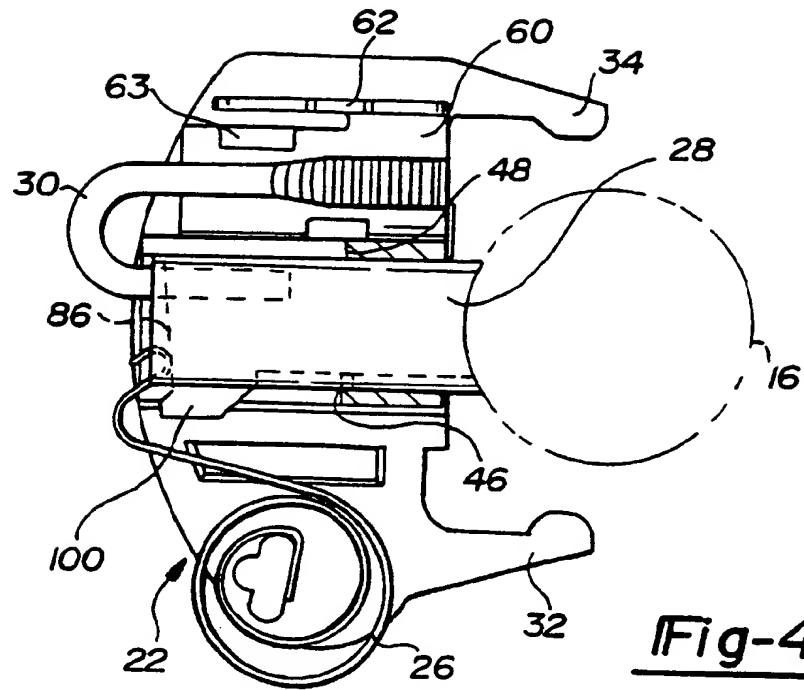


Fig-2

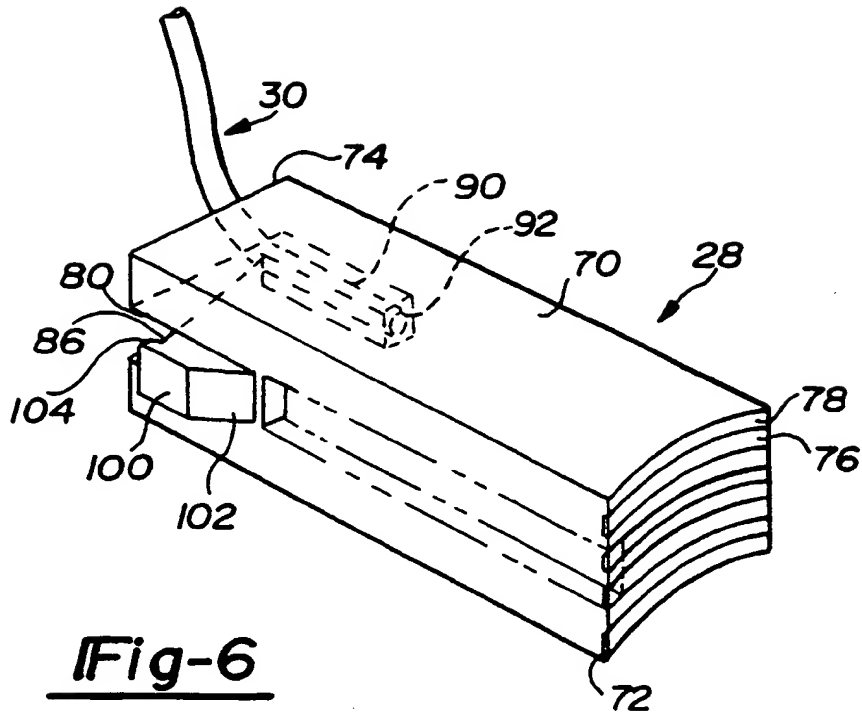




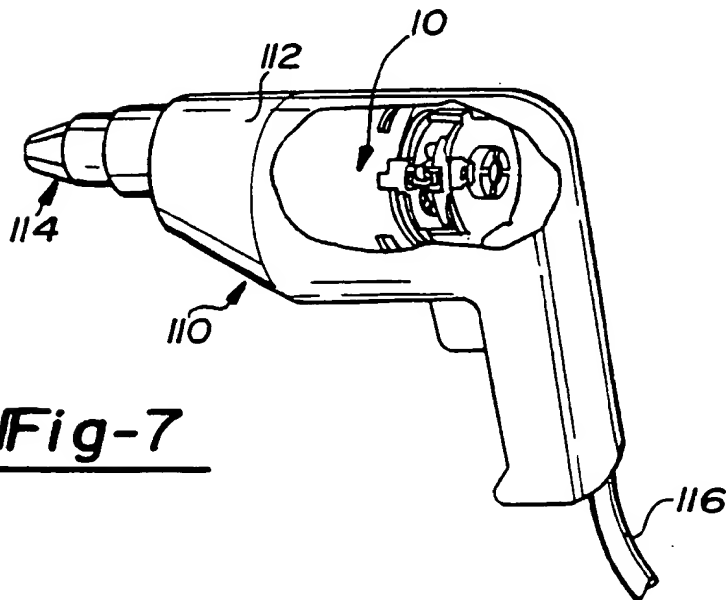
**Fig-3**







**Fig-6**



**Fig-7**

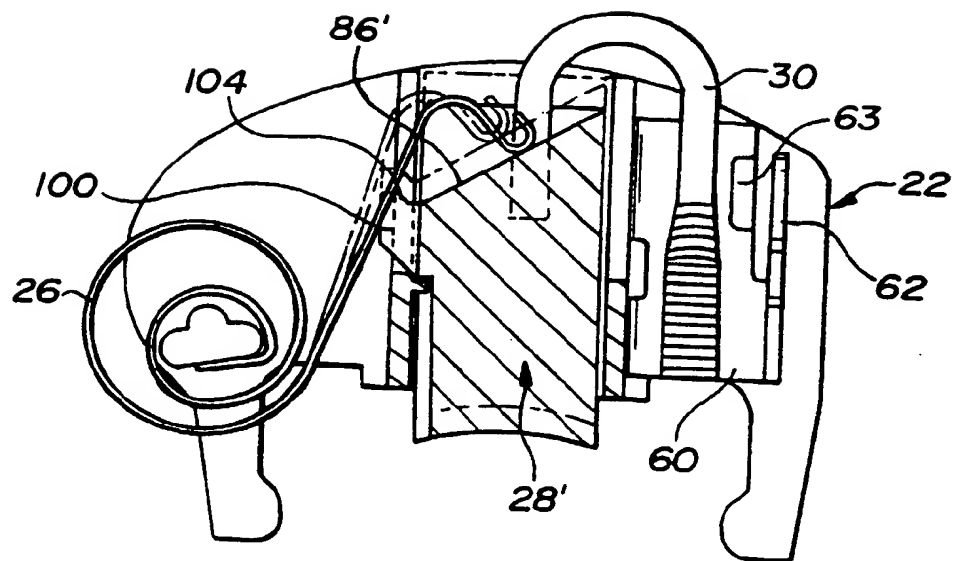


Fig-8

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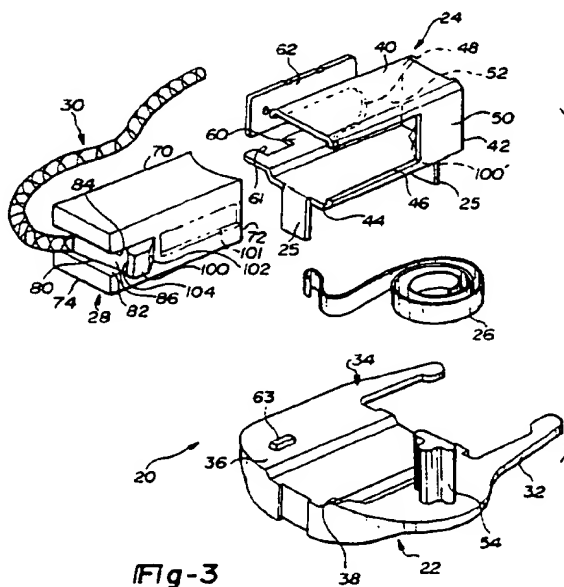
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### (54) Brush assembly

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**Fig-3**

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# EUROPEAN SEARCH REPORT

Application Number  
EP 99 30 0836

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (InCL6)
Y	US 4 163 167 A (DIPPOLD WILLIAM L ET AL) 31 July 1979 (1979-07-31)	1.7	H01R39/38 H02K5/14 H01R39/40
A	* abstract; claims; figures *	2-6	
Y	US 4 559 465 A (GAGNEUX GEORGES C) 17 December 1985 (1985-12-17)	1.7	
A	* the whole document *	2-6,8-15	
A	US 4 041 339 A (HUBER DAVID A ET AL) 9 August 1977 (1977-08-09)	1-15	
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A,D	US 5 714 826 A (NOSAKA KOJI ET AL) 3 February 1998 (1998-02-03)	4,9,15	TECHNICAL FIELDS SEARCHED (InCL6)  H02K H01R
A	US 4 843 274 A (PAISLEY THOMAS D) 27 June 1989 (1989-06-27)	4,9,15	
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The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>4 May 2001</b>	Examiner <b>Durand, F</b>
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document X : particularly relevant if taken alone V : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document	

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ON EUROPEAN PATENT APPLICATION NO.**

EP 99 30 0836

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